THE DETERMINATION OF ICE CREAM AS A FACTOR IN THE SPREAD OF TYPHOID FEVER INFECTION.

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AN OUTBREAK of typhoid fever in Birmingham, Ala., in the summer of 1916, and another in Chattanooga, Tenn., in the summer of 1917, were found on investigation to present strikingly similar epidemiological features. From the evidence obtained it was concluded that each of these outbreaks was caused by ice cream borne infection.

The outbreak in Birmingham occurred in the period June 9 to July 15, and comprised about 350 cases in excess of the average number for the corresponding period of the several previous years. The outbreak in Chattanooga occurred in the period July 15 to August 15, and comprised about 75 cases in excess of the average number for the corresponding period of the several previous years.

The excessive case incidence in Birmingham was 1 to about 428 of population, and in Chattanooga 1 to about 666 of population. In each outbreak the excess of cases over the usual corresponded approximately to the excessive number of cases giving a definite history of exposure to the implicated ice cream supply.

EPIDEMIOLOGICAL FEATURES.

The findings in each of these two outbreaks are regarded as fairly representative of the epidemiological features which may be expected generally to be found in extensive urban outbreaks of typhoid fever caused by ice cream borne infection.

Distribution. The disease spread generally throughout the city and fell especially upon the better residential sections. The case incidence was higher among those living under the best sanitary conditions than among those living under the poorest sanitary conditions. Children between five and fifteen years of age living under good economic conditions furnished a strikingly large proportion (about 30 per cent.) of the cases. At several places outside the city at which, during the period of causation of the outbreak, some of the suspected ice cream supply was distributed, groups of cases among users of the ice cream developed synchronously with the cases constituting the outbreak in the city. The distribution of the outbreak corresponded roughly to the distribution of the implicated ice cream supply.

Character. Each of the outbreaks was somewhat explosive in character. The periods of causation appeared to be about one month in duration. In each instance, however, between 30 and 40 per cent. of the cases developed within a period of seven days, suggesting that the outbreak may have been caused in large part by infection distributed in one day. The cases generally appeared in duration of attack, in severity of symptoms and in fatality to strike a medium between the aver-

age for outbreaks caused by water-borne infection and the average for outbreaks caused by milk-borne infection. A particularly interesting feature was the frequency of short prodromal periods. A large majority of the cases gave a history of prodromes for about three days. The sudden development of severe symptoms causing the person to take to bed at once was much less frequent than is the rule in instances of milk-borne infection.

Dosage. The number of cases to develop among persons who within the two years prior to the attack had received anti-typhoid inoculation suggested that the dosage of infection, as has been found to be the case in milk-borne infection,* was sufficient to overcome the resistance furnished by the inoculation. The proportion of the population of Birmingham and Chattanooga which prior to the outbreaks had been inoculated against typhoid is not known. It is improbable, however, that it reached 10 per cent. Between 5 and 10 per cent. of the cases in each outbreak gave a history of having had the inoculation within two years prior to onset of illness. Whether the vaccine which had been used in these persons was of standard potency is not known. But along with the outbreak in Chattanooga, a group of cases of typhoid fever developed among soldiers at Fort Oglethorpe, Ga., who had been exposed to the ice cream supply. All of the cases in this group were in persons who within the two years—and some within three months—prior to attack of illness had been inoculated with army vaccine. It is assumed that the potency of the army vaccine was up to standard.

*Geiger, J. C.: A milk-borne epidemic of typhoid fever due to the use of polluted water, with five failures of typhoid immunization.—Jour. A. M. A., March 31, 1917, p. 978.

Determination of Ice Cream as Vector of Infection

In extensive and explosive outbreaks of typhoid fever in cities, such as the one in Birmingham and the one in Chattanooga, the general epidemiological features suggest that the vector of infection has been some drink or food extensively distributed over the city. The geographical distribution and the class of persons especially affected, if ascertained with a reasonable degree of accuracy, tend to eliminate flies, personal contact and local insanitary conditions as preponderant factors in the spread of the infection. To bring under reasonable suspicion or to eliminate definitely a water supply or a milk, ice cream or other food supply, good leads can be found as a rule only by a careful collection of detailed data at the homes of the individuals attacked with the disease.

Accurate Collection of Data. Definite histories about one's use of water supplies and milk supplies are as a rule more easily obtainable than is the history of exposure to ice cream supplies. One who is fond of ice cream and who is able to indulge freely in this delicacy will usually, within any period of two or three weeks in the summer season, have eaten ice cream in a number of different places. Free users have difficulty in recalling even the majority of the places at which

they have recently eaten ice cream. The most important light on the situation may be obtained from the histories of persons affected who have eaten ice cream only a few times—perhaps but once—within the two or three weeks prior to onset of illness. Whenever practicable, the patient should be interviewed. Unless the interview at the home of the patient and at the other places at which the ice cream was eaten is conducted painstakingly, tactfully and thoroughly, the history of exposure of the person affected to the infected ice cream supply may be readily missed. The following is typical of many instances in the course of the investigation in Birmingham and Chattanooga: The mother of the boy ill with typhoid is interviewed.

QUESTION. "Did your son eat ice cream within the two or three weeks before he took sick?"

ANSWER. "No, he did not like ice cream."

Q. "Are you sure he did not eat it at all?"

A. "He may have, but he certainly did not eat it often."

Q. "Can you recall any time when he did eat it?"

A. "Let me see. Why, yes, now I remember, he did eat ice cream once at the drug store down here at the corner."

Q. "When was that?"

A. "It was about two weeks before he took sick."

Q. "Do you know what ice cream is served at the drug store?"

A. "I think it is the 'A' ice cream."

Q. "But you are not sure?"

A. "No, I am not sure."

Q. "Do you think the little boy ate ice cream at any place besides this drug store?"

A. "No, I'm pretty sure he did not."

It is then ascertained that the patient is well enough to be interviewed.

Q. "John, how about ice cream, did you eat it sometimes in the two or three weeks before you got sick?"

A. "Yes, sir, every now and then."

Q. "Where did you eat it?"

A. "At the corner drug store."

Q. "Anywhere else?"

A. "Yes, at the confectionery shop across the street.."

Q. "About how many times in the three weeks before you got sick did you eat ice cream at the confectionery shop?"

A. "Three or four times."

A visit is then made to the drug store and to the confectionery shop and the proprietor at each is interviewed.

Q. "What ice cream do you sell?"

A. "B's."

Q. "Any other?"

A. "No."

Q. "Have you sold any obtained from any manufacturer other than 'B' within the last six months?"

A. "No, I've been getting my supply from 'B' for over three years."

Q. "You have not run short at any time within the last eight weeks and bought a part of your supply from some other manufacturer?"

A. "Why, yes, for two or three days sometime ago 'B' was unable to supply me and I bought from 'X'."

Q. "Will your books show when that was?"

A. "Yes (looking at books), it was July 15, 16 and 17." The onset of illness of the patient was July 28.

Implication of Ice Cream Supply. By carefully collecting in this way the data about foods and beverages, evidence may be obtained early in the investigation of an outbreak caused by ice cream borne infection pointing to the ice cream supply which is responsible. The proportions of cases giving a history of exposure to the different ice cream supplies must be compared with the proportions of the total ice cream supply of the city which are furnished by the different dealers before a conclusion is reached that the number of cases among the users of ice cream from any one supply is excessive. In the Birmingham outbreak 55 per cent. of the cases gave a definite history of exposure to one ice cream supply which furnished less than 20 per cent. of the total supply of ice cream consumed in the city. In the Chattanooga outbreak 86 per cent. of the cases gave a definite history of exposure to one ice cream supply which furnished, according to the most reliable evidence obtainable, about 30 per cent. of the total supply of ice cream consumed in the city. In each of these outbreaks the number of cases among the users of ice cream from other large supplies was roughly proportionate to the amount of ice cream distributed. In outbreaks such as the one in Birmingham and the one in Chattanooga, the preponderance of cases among the users of ice cream from one supply is regarded by the writer as practically conclusive evidence that the ice cream supply has been the vector of the infection, unless it can be established beyond reasonable doubt that the ingredients of the ice cream and the ice cream itself have been collected and handled in such a way as to prevent the introduction of infection, or that they have been treated in such a way as to insure destruction of whatever infection may have been introduced into them. The finding of a case of typhoid fever or a carrier of typhoid infection at one of the farm sources or at the factory furnishes corroborative evidence, but does not appear essential to the reaching of a definite epidemiological conclusion. The case or carrier furnishing the infection may have recovered or have left the premises before the search for the human source of the infection at farms and factory is begun. The ice cream supplies concluded to be responsible for the outbreaks in Birmingham and Chattanooga were found at both farm and factory sources to have been exposed through fingers, flies and other agencies, to contamination with human excreta. In the period of causation of the Birmingham outbreak three cases of typhoid fever existed at one of the dairy farms supplying milk used in the manufacture of the implicated ice cream supply. The existence of the cases and the insanitary conditions in respect to the disposal of human excreta on these premises were suggestive, but not *proof* that the infection causing the outbreak had its origin at this farm. The mixture for making the ice cream implicated in the Birmingham outbreak was not pasteurized nor otherwise treated so as to

destroy whatever infection may have been introduced into it at its sources. The mixture for making the ice cream implicated in the Chattanooga outbreak was invariably, according to the evidence, run through a "flash" pasteurizing machine, but it was positively established that this machine on some occasions did not pasteurize.

Elimination of Other Potential Factors. In both the Birmingham and the Chattanooga outbreaks factors other than ice cream likely to operate in the spread of infection causing such outbreaks were eliminated on epidemiological evidence obtained from field and laboratory studies. There was no suggestive preponderance of cases among the users of milk from any supply other than those used in the making of the implicated ice cream. In the periods of causation of the outbreaks the public water supplies were free from all evidence of dangerous pollution. The number of cases giving a history of exposure to water supplies other than the public city supplies was not sufficient to signify that these water supplies had played a very considerable part in the spread of the infection. The public water supply of Birmingham is obtained from two different sources and treated and distributed from two different plants. In the period of the outbreak the prevalence of typhoid fever was just about the same in the areas of the city supplied with water from the two different sources.

Conclusions.

1. The part played by ice cream, though probably not relatively so great as the part played by water, milk, fingers or flies in the spread of typhoid and other infections, is important and deserving of the serious attention of health officials.

2. The dosage of typhoid infection in ice cream may be sufficient, as is the case with milk supplies, to overcome the additional resistance furnished by anti-typhoid inoculation and for that reason the elimination from the dietary of vaccinated persons, including the military forces, of ice cream which is not determined with reasonable certainty to be free from the likelihood of infection is of particular importance.

3. Unless investigations of typhoid situations are conducted painstakingly and thoroughly, evidence which would definitely establish an ice cream supply to be the vector of infection may be missed.

4. Extensive outbreaks of typhoid fever caused by ice cream borne infection can be readily determined by careful epidemiological studies, but even very careful and thorough investigations may fail to determine the medium of conveyance in small numbers of cases caused by ice cream borne infection.

5. The exercise of cleanliness in the collection and preparation of all ingredients entering into the composition of ice cream supplies, the proper pasteurization of ice cream mixtures, and the exercise of a high degree of cleanliness in the manufacture and distribution of ice cream—all under rigid and adequate official supervision—are highly indicated in order that this delectable and economic delicacy may be distributed freely and safely for human consumption.